SPECTRUM
HUES OF SCIENCE

ISSUE NO : 13

In The News

A Pandemic: COVID-19

Ojal D'Cunha, M.Sc.
Sophia College (Autonomous)

The global spread of Coronavirus Disease 2019 (COVID-19) is the largest public health issue in our generation. Consequently, all the schools and colleges in India are currently closed as a precautionary measure to combat the coronavirus outbreak which has made all of us curious about this pandemic.

The most commonly asked question is, what is COVID-19? This disease results in fever, severe respiratory illness and pneumonia. It is caused by a virus identified as Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) that belongs to the coronavirus family. The virus has a single strand of RNA as its genetic material in a protein shell that is surrounded by an envelope made of lipids and has spike proteins that protrude on its surface giving it a crown like appearance ('corona' is the latin for word crown). This type of virus is present in many species of birds and animals as well.

Coronaviruses have also been the cause of epidemics of the past like Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV) of 2002 and Middle East Respiratory Syndrome Coronavirus (MERS-CoV) that arose in 2012 and still remains in circulation in camels!

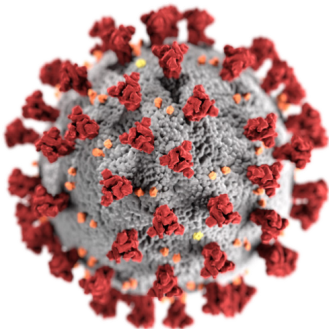

Illustration of how a coronavirus with its spikes would look at very high magnification
(https://phil.cdc.gov/details.aspx?pid=23312)

So how does the viral infection occur? Once the virus has entered the body, the spike proteins on the viruses bind to specific receptors like a key fitting a lock to enter human cells and begin to replicate. As the receptors (which are called ACE2) are commonly found on the cells that line the upper respiratory tract, the infection results in irritation of the upper throat causing initial symptoms like dry coughs. The infection then travels to the lungs in the lower respiratory tract and the symptoms worsen causing breathing problems.

How does the disease spread? COVID-19 is mainly spread from person to person through close contact and dispersion of respiratory droplets that contain the virus which are released while coughing or sneezing by an infected individual. Touching contaminated surfaces and then touching your face can also cause infection as the virus is found to remain stable for several hours to days in aerosols and on surfaces.

What are some preventive measures that one can take to avoid infection? Rinsing your hands with soap for a minimum of 20 seconds breaks the viral envelope and kills it. Avoiding getting infected by means of social isolation, frequent washing of hands with soap, regular disinfection and cleaning of frequently touched objects and surfaces with household cleaners or alcohol-based disinfectants is the best way to battle this pandemic.

Is social distancing the best way to combat the spread of COVID-19? It is rightly said that, "Prevention is better than cure". Once infected, a person may not show any symptoms for about 2-14 days but may go on infecting others unknowingly during this asymptomatic period. Hence, it is best to avoid the spread of infection by following preventive measures like quarantining and social distancing, so that by the end of this quarantine the infected individuals would recover and be unable to spread the disease.

Thus, stay home, stay safe and help fight against COVID-19!

FURTHER READING:

1.For an animated description of the disease process check out the YouTube video "Covid -19:An Illustrated Scientific Summary" by the Yale School of

Medicine. (https://youtu.be/AaXZflLkB80)

2. To understand how simulated models are used to predict the exponential spread of the disease and the importance of social distancing check out the YouTube video "Simulating an epidemic" by '3Blue1Brown' (https://youtu.be/gxAaO2rsdIs)

3. N van Doremalen, *et al.* Aerosol and surface stability of HCoV-19 (SARS-CoV-2) compared to SARS-CoV-1.*The New England Journal of Medicine*. (2020) https://www.nih.gov/coronavirus

Insight

The Army of Our Body

Sasha Fernandes, SYBSc,

St. Xavier's College (Autonomous) Mumbai

We are constantly surrounded by enumerable microorganisms, both good and bad. There are more microorganisms in and on our body than cells! Infections like the current COVID-19 pandemic are caused by viruses. Every microorganism that enters our body does not cause disease since we have a strong army within us, the immune system. The immune system is made up of cells, tissues and organs that work in unison. Disruption such as diseases can cause chaos in our body, while our immune system helps bring order.

Before an organism can enter our body there are many physical, chemical and mechanical defences that play an important role. Our skin is made up of epithelial cells that keep shedding, removing microbes attached to them. The skin releases sweat that can evade unwanted microorganisms. Mucous in different parts of the body have chemicals that inhibit the growth of microorganisms. Tears and saliva also have anti-microbial properties. Parts of our body such as the stomach and vagina which are acidic in nature, allow its microflora to grow and inhibit other unwanted microorganisms.

However, if these microbes do enter, our White Blood Cells (WBCs) which are specialized immune cells come into play. Monocytes and macrophages are highly phagocytic (capturing and engulfing unwanted materials). Lymphocytes are of three types; T cells, B cells and natural killer (NK) cells. The B cells release specific antibodies which neutralize toxins and help in identifying pathogens for elimination. T cells can directly target and kill many pathogens Some T and B cells, retain a memory of the pathogen that caused an infection and protect against future attacks. Other WBCs like Basophils, Eosinophils, Neutrophils and Mast cells use various strategies that help combat infections.

Viruses (like the current coronavius) are microbes that can replicate only inside a living cell. Since the virus lives inside a cell it cannot be recognized directly by the immune cells. However, the host cells harbouring the virus can display parts of the virus on their surface allowing the immune cells to mount a response. Besides the B and T cells, NK cells are also effective against viral infections. The antibodies produced bind to the virus externally and either neutralise or block its interaction with the host. The immune system has many more layers of complexity. The beauty is how all of these come together to protect our body from an invading pathogen. This is one strong and beautiful natural army that works in various ways to bring order to any disorder created by an unwanted outsider!

REFERENCES:

1. Willey, J. M., Sherwood, L., Woolverton, C. J., & Prescott, L. M. (2008). *Prescott, Harley, and Klein's Microbiology.* New York: McGraw-Hill Higher Education.

2.Laing,K. Immune Responses to Viruses. Retrieved from The British Society of Immunology.https://www.immunology.org/public-information/bitesizedimmunology/pathogens-and-disease/

Through The Lens

Bushra Nirban,SYBSc,

Sophia College (Autonomous)

Can you identify the specimen in the photograph?

Science In Daily Life

Saliva-Life's Magic Potion

Michelle Pereira M.Sc.

Sophia College (Autonomous)

Do you recall those tired nights wherein you are snoring away into a wonderful dream and you suddenly shift your head to another side of the pillow and wham; there goes your face in a pool of saliva? All grossed up and half asleep you try to wipe your face and ah, you've been drooling like a baby. Well, agreed that it sounds pretty gross but we have all

had one of those nights. If you've faced nights like these then you should consider yourself lucky. Not everybody knows what that little volume of saliva can do. This small volume of saliva can protect you and take your health from bad to really very good.

Your mouth is referred to as 'Oral' or 'Buccal cavity.' The oral cavity has 3 major glands secreting saliva: Parotid, Sublingual and the Submandibular glands and several minor glands which together aid in producing approximately 0.6 litres of saliva per day. Saliva in your oral cavity is being secreted continuously, thus this gives an idea that there is a continuous role that it must be playing in the body. Well, surprisingly it plays more roles than you have ever imagined. It lubricates your teeth and tongue and this mechanism also helps you articulate words Well, I am sure that is not the kind of detail you were eager to know unless you wish to make a speech in your sleep!

Nonetheless, saliva acts as a buffer and maintains pH (the level of acidity) which is very crucial. pH plays a very important role when it comes to housing oral microflora. These are similar to the "good gut bacteria" in your intestines and perform functions quite similar to them. Their primary function is to break down food particles. Thus, without saliva, digestion would not kick start the way it should. Particularly when you are sleeping, all the digestion processes are taking place in your stomach and in your gut. That does not mean the job of saliva ends there. Saliva is known to prevent demineralization of the tooth enamel as it exhibits antimicrobial action due to the presence of components like lysozyme and lactoperoxidase.

Saliva has an important antibody that is IgA. It is also known to have a natural sedative called Orpiorphin. Obviously, it is not present in generous amounts otherwise we would be woozy. There's just the right amount of the painkiller in your mouth, enough to deal with burns and chars caused by the extra hot chilli sauce in your pizza that you had for dinner. Occasional drooling is not bad because it prevents a condition called 'Xerostomia'. It is a condition that causes dryness of the mouth and throat, due to lack of saliva production accompanied by frequent awakening at night to quench thirst. Also drooling is caused when one sleeps with their jaws open resulting in saliva to flow out of the mouth. This indicates that one is getting undisturbed, sound sleep and that one might be in their REM (Random Eye Movement) phase, which is the most important part of sleep. Thus, saliva does so much more than just aiding in mastication. So, the next night when you find your pillow a little damp, hug your pillow tight and know that you are sleeping right.

FURTHER READING:

Enders G., Gut: The inside story of our body's most underrated organ. Greystone Books, 2014.

Stimulate Your Grey

Cyrus Khan,
Science Communicator

If a person with an infection can spread it to 3 people every day, (and each person they infect will do the same), how many many days will it take for 1 million people to be infected? Assume no other factors are playing a role in the spread of the disease.

A) 14 days B) 140 day C)1400 days D)14000 days

(Not so) Long, Long Ago

Social Behaviour in *Drosophila* and other Animals- Lessons We Can Learn about Social Distancing

Sanjana Krishnakumar, TYBSc,
Sophia College (Autonomous)

The COVID-19 Pandemic has prompted all world leaders to ask their citizens to stay at home. But human beings are social creatures and some of us are struggling to stay away from our loved ones. While this may seem unnatural, what if we look for some wisdom in the animal kingdom?

In order to study the effects of exposure to a chemical known as Bisphenol- A (BPA), I chose *Drosophila melanogaster* as a model organism. As BPA is said to predispose an individual to diseases of the Autism Spectrum, I expected to see changes in social behaviour. However, *D. melanogaster* is not often thought of as a social animal. While thinking about ways in which I could assess social behaviour, I came across an assay known as the Social Space assay.

Social space is the distance maintained between two individuals in a group setting. It is often assayed in order to look at the spacing between individuals in a group or an aggregate. Canton-S flies are seen to maintain a social space of at least two body lengths in a social group. A social space assay to study social behaviour in *Drosophila melanogaster* was standardised by Simon, et al. In the social space assay, a narrow triangular chamber was created and flies were introduced into the chamber. The flies would naturally start moving upwards but would have to choose between settling at the top of the chamber or maintaining social space. A video of the experiment is included on the Spectrum website.

Upon reading further, I found out that social space is maintained by most animals that live in groups or communities. For most animals, the social space is always greater or equal to their own body lengths. For instance, gulls maintain a social space of one

body length in a flock while flying and tufted ducks maintain a space of 2-3 body lengths. It is a well-known fact that diseases spread quickly in a densely populated community. This is because all animals in a habitat share resources and living space. They also interact with each other at all times and thus increase transmission. When a habitat gets extremely crowded or over- populated, it is seen that these animals still maintain social space and avoid physical contact. This is particularly helpful as this reduces the transmission of diseases.

As we go through a global pandemic today, with all governments urging us to practice social distancing, we cannot help but wonder how it helps. But when we look at so many animals that have been practicing social spacing throughout evolution, it should become apparent to us that it merely helps us curb the spread of the disease. Like all other animals, human beings too, are social creatures and we live in communities where we help other human beings. If we take a good look at our animal counterparts, reflect on their practices, and cooperate with each other, we could curb the spread of the disease and save many lives.

REFERENCES & FURTHER READING:

Simon, A. F., Chou, M. T., Salazar, E. D., Nicholson, T., Saini, N., Metchev, S., & Krantz, D. E. (2012). A simple assay to study social behavior in Drosophila: measurement of social space within a group. *Genes, brain, and behavior, 11*(2), 243–252.

Ramdya, P., Schneider,J., Levine, J. D.(2017). The neurogenetics of group behavior in Drosophila melanogaster, *Journal of Experimental Biology 220*: 35-41; doi: 10.1242/jeb.141457

https://www.britannica.com/topic/animal-social-behaviour/The-range-of-social-behaviour-in-animals

Thought Byte

The fact that viruses have been afflicting humans since the beginning of written history is indisputable. Pock marks similar to those of smallpox have been found on the face of a mummified Pharaoh recovered from the pyramids of Egypt. Some drawings on the tombs from the same period indicate wasting of limbs that could be due to polio virus. It has been suggested that viral infection of humans occurred as a result of transition from a hunter- gatherer society to a settled agricultural society with the domestication of other mammalian species and the transfer of viruses from these animals to humans. The primitive hunter may have been a healthier person than the settled `gatherer' since he lived a more isolated life, without any crowding. The proximity to domesticated animals and groups of people living under one roof probably resulted in introduction of new infections to the human population. Examples of this have occurred with human infections in the last few years, with the spread in avian flu, SARS, and HIV – all from other animals.

Milton W. Taylor In Viruses and Man: A History of Interactions, Springer, 2014

Answer to 'Through the Lens': It is a skeletonized teak leaf. *Eutectona machaeralis* (a moth larva) causes skeletonization of teak leaf. Devastated yet elegant.
Answer to 'Stimulate Your Grey': A) 14 days

This is a collaborative endeavour of the Department of Life Sciences, Sophia College - Autonomous, Mumbai and the Department of Life Science and Biochemistry, St. Xavier's College - Autonomous, Mumbai; under the DBT STAR college scheme

Layout and design by **Kennith Castelino,** TYBSc and **Pooja Mehta**, SYBSc, St. Xavier's College - Autonomous, Mumbai

Write to us at spectrumsciencemagazine@gmail.com. Spectrum archives available at spectrumsciencemagazine.com